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The *Thalassoduvallius* (Coleoptera, Trechinae) of the Izu Area, Central Japan

By

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上野俊一*：伊豆地域のイソチビゴミムシ

The genus *Thalassoduvallius* is a group of medium-sized trechine beetles peculiarly specialized in both the morphological and ecological aspects. They are microphthalmic, apterous and more or less depigmented, and though not so highly specialized as the members of the subtribe Aepina, strictly adapted for littoral life. This is very exceptional for a species of the subtribe Trechina, flightless members of which are mostly monticolous and mesophilous.

A trechine belonging to *Thalassoduvallius* was first met with by Kazuyoshi KUROSA in 1946, but his specimen, later named *T. kurosai* (UÉNO, 1956, p. 67, fig. 3), was accidentally found in a channel of sewage at the port of Uwajima on the western coast of Shikoku. In 1953, a second form of the same genus was discovered by Kôzaku MASIDA at the estuary of the Sufu-gawa River near the western end of Honshu. His investigation clarified that the trechine normally lived under a large heap of stones accumulated in the intertidal zone and periodically submerged at high tide. Only four specimens in total were obtained at this locality, but as even the short series of specimens was much better for taxonomic purposes than KUROSA's solitary one, the trechine, named *T. masidai* (UÉNO, *op. cit.*, p. 65, figs. 1-2), was selected for the type of the new genus.

Describing these forms as two new species, I was not thoroughly convinced of their specific independency (cf. UÉNO, *op. cit.*, p. 68). It was, however, difficult to draw a final conclusion at that time, because I was not aware of the range of variation of *T. kurosai*. Even now, the situation has not been improved as regards the Uwajima form, since no additional specimens nor its true habitats have been met with in spite of careful investigations made for more than thirty years in the vicinities of Uwajima. On the other hand, new evidences have been obtained in Central Japan since then, and I am now of the opinion that the genus *Thalassoduvallius* comprises only one polymorphic species.

At the beginning of 1950's, Hitoshi HASEGAWA came across a trechine beetle on his collecting trip to Cape Manazuru-misaki about 70 km to the southwest from Tokyo. On his information, Yoshihiko KUROSAWA, together with Akira YOSHIDA, paid a visit to the

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cape several years later and obtained some specimens of the trechine, three of which are now preserved in the collection of the National Science Museum (Nat. Hist.), Tokyo. In 1962, when I moved from Kyoto to Tokyo, I became aware that the trechine belonged to *Thalassoduvallius*, visited the cape with KUROSAWA, and collected a long series of its specimens, long enough to show every aspect of its variation. However, as the Manazuru form is so close to the Uwajima one, I have long refrained from naming it, looking for other populations of *Thalassoduvallius* in the wide intervening areas between Cape Manazuru-misaki and Uwajima. Though my efforts have not been repaid until now, I was able to locate a fourth locality of *Thalassoduvallius* on the Island of Oh-shima off central Honshu. Since the occurrence of an apterous trechine on this recent volcanic island is of some interest from the zoogeographic point of view, I am taking this opportunity to introduce the *Thalassoduvallius* from Central Japan into science.

To facilitate comparison between the three races of *T. masidai*, I will give in this paper a full description of the new subspecies, in which standard ratios of the other subspecies are also noted. The abbreviations used are the same as explained in other papers of mine.

Before going further, I wish to thank Dr. Yoshihiko KUROSAWA for his friendly help in searching for this interesting trechine beetle.

***Thalassoduvallius masidai pacificus* S. UÉNO, subsp. nov.**

(Figs. 1-3)

Length: 3.90-5.00 mm (from apical margin of clypeus to apices of elytra).

Very closely allied to *T. masidai kurosai* (stat. nov.), but the head is smaller, the pronotum is wider at the base on an average, and the pronotal sides are less strongly and less evenly arcuate. From *T. masidai masidai*, this new subspecies is readily distinguished by the following points: head relatively small and less transverse, having much less convex genae; pronotum with longer basal part, the sides of which are usually convergent posteriorly, and with shallower ante-basal sinuation; pronotal hind angles less sharp though frequently denticulate at the tips; elytral striae shallower, especially at the side; basal part of aedeagus shorter, thicker and more strongly bent.

Head and prothorax dark brown, with the exception of lateral parts of pronotum and propleura which are more or less reddish, hind body reddish brown on both the dorsal and ventral surfaces, shiny, more or less translucent when alive; labrum, palpi, apical half of antennae, and legs light reddish brown.

Head relatively small and narrow, with frontal furrows obtusely subangulate behind clypeal suture, slightly sinuate at middle, and then strongly curved to neck constriction, which is sharp at the sides; frons and supraorbital areas moderately convex; microsculpture reticulated and sharply impressed, the meshes being largely isodiametric though partially wide; eyes small though variable in size, a half to five-eighths as long as genae, which are moderately convex at the posterior parts but rather flat behind eyes; antennae usually reaching the middle of elytra in ♂, more or less shorter than that in ♀, segment 2 the shortest, about three-fifths as long as segment 3 or 4, segments 5-10 cylindrical, gradually

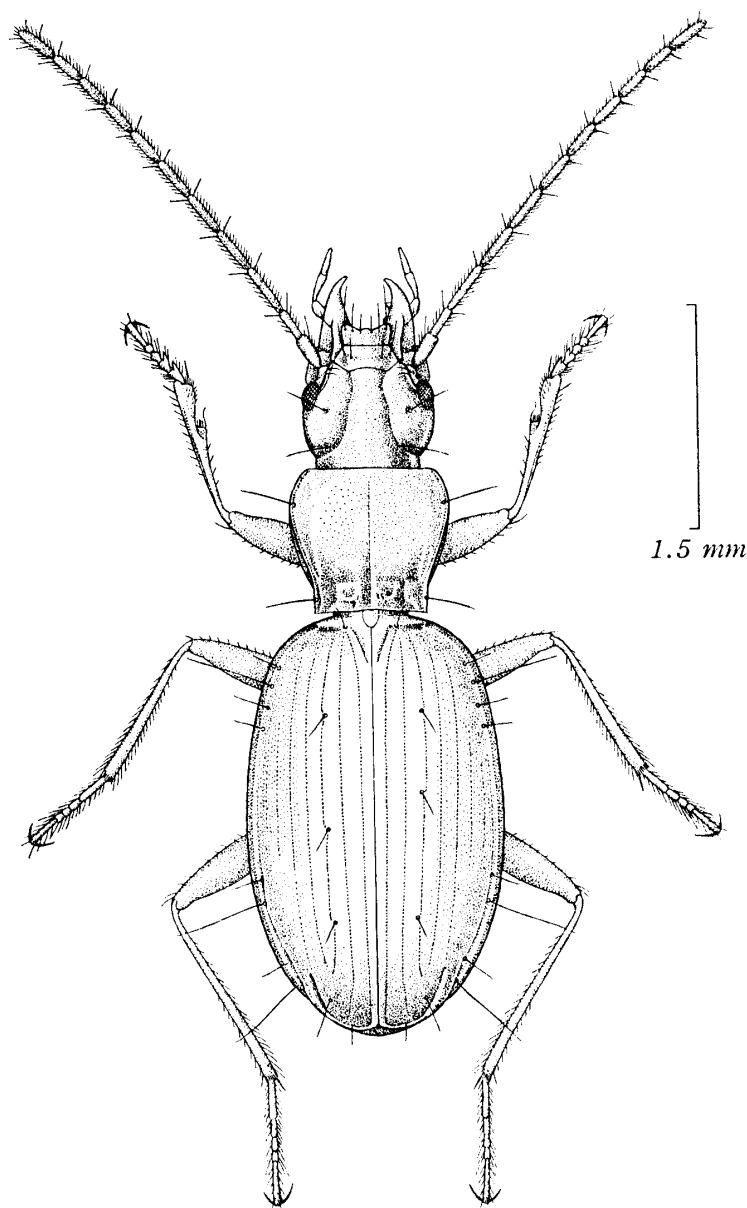


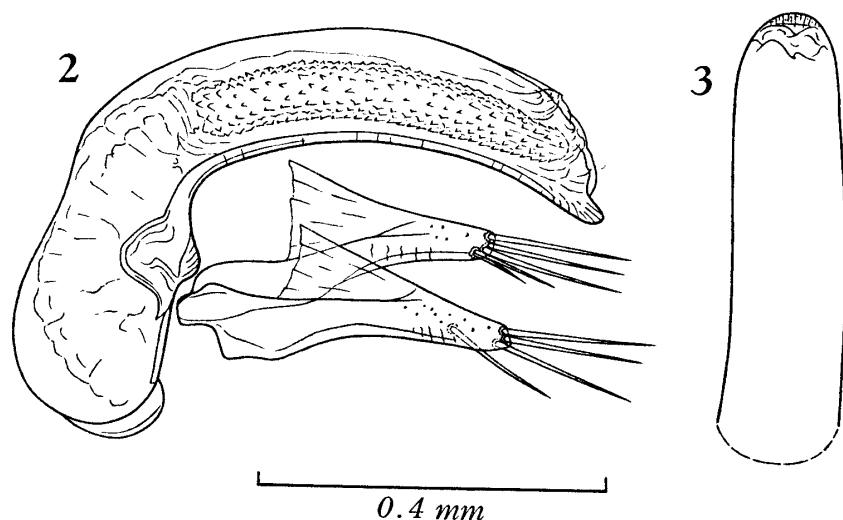
Fig. 1. *Thalassoduvallius masidai pacificus* S. UÉNO, subsp. nov., ♂, of Cape Manazuru-misaki.

decreasing in length towards terminal segment, which is about as long as segment 7 and obviously shorter than (about five-sixths as long as) segment 3.

Pronotum cordate and convex, distinctly wider than head, a little wider than long, widest at about two-thirds from base, and more gradually contracted posteriad than anteriorly; PW/HW 1.17–1.24 (M 1.20) [1.16–1.17, M 1.16, in *T. m. masidai*, 1.15 in *T. m. kurosai*], PW/PL 1.07–1.15 (M 1.11) [1.05–1.12, M 1.08, in *T. m. masidai*, 1.11 in *T. m. kurosai*], PW/PA 1.36–1.49 (M 1.42) [1.30–1.36, M 1.33, in *T. m. masidai*, 1.35 in *T. m. kurosai*], PW/PB 1.37–1.46 (M 1.41) [1.37–1.44, M 1.40, in *T. m. masidai*, 1.49 in *T. m. kurosai*]; surface smooth; microsculpture distinct, consisting of fine transverse lines and

meshes; sides moderately arcuate near front angles, rather feebly so at middle, shallowly sinuate at about one-fifth from base (though the ante-basal sinuation is variable in its position and curvature according to individuals), and then usually convergent (sometimes subparallel) towards hind angles, which are either rectangular or somewhat obtuse and frequently bear a minute denticle at each tip; apex about as wide as base, PA/PB 0.95–1.06 (M 1.00) [1.04–1.08, M 1.06, in *T. m. masidai*, 1.10 in *T. m. kurosai*], with front angles narrowly rounded off and not advanced; base either straight or very slightly emarginate; median line very deep though hardly widening basad; apical transverse impression almost obsolete; basal transverse impression shallow, uneven, interrupted at middle and laterally merging into large basal foveae; postangular carina very obtuse though usually distinct; basal area longitudinally strigose.

Elytra elongated oval, well convex, much wider than prothorax, widest at about middle, and equally contracted towards bases and towards apices; EW/PW 1.57–1.70 (M 1.65) [1.60–1.69, M 1.65, in *T. m. masidai*, 1.62 in *T. m. kurosai*], EL/EW 1.52–1.63 (M 1.58) [1.57–1.59, M 1.58, in *T. m. masidai*, 1.63 in *T. m. kurosai*]; microsculpture composed of fine transverse lines; shoulders rounded, with prehumeral borders usually less oblique than in the other subspecies and slightly arcuate; sides feebly arcuate, with distinct preapical emargination; apex of each elytron either subangulate or rounded, usually forming a small re-entrant angle at suture; striae deeply impressed and distinctly crenulate on the disc, but becoming shallower and sometimes almost obsolete at the side, striae 4–7 obsolete near base, 6–7 also obsolete apically, 8 deeply impressed in apical half; scutellar striae long and deep; apical striae deep, moderately curved, joining or almost joining stria 5; intervals smooth, moderately convex on the disc but flat at the side; apical carina prominent; stria 3 with three setiferous dorsal pores (including anteriorly situated preapical pore) at $1/5-1/4$, $2/5-1/2$ and $2/3-3/4$ from base respectively, the preapical pore being frequently located on interval 3 at an anastomosis of striae 2 and 3.



Figs. 2–3. Male genitalia of *Thalassoduvallius masidai pacificus* S. UÉNO, subsp. nov., of Cape Manazuru-misaki. —2. Left lateral view. —3. Apical part of aedeagus, dorsal view.

Ventral surface smooth; prosternum provided with several hairs; anal sternite with a pair of sexual setae in ♂, with two pair of the setae in ♀. Legs fairly long and slender; each protibia deeply grooved on the external face and minutely pubescent on the anterior face at its apical portion; tarsi thin though the metatarsi are rather short, each protarsus with two proximal segments widely dilated and stoutly produced inwards at apices.

Male genital organ similar to that of *T. m. kurosai*, not so elongate in aedeagal basal part as in *T. m. masidai*. Aedeagus very small, about one-fourth as long as elytra, tubular, gently arcuate, and strongly bent at the basal part, which bears a small sagittal aileron; apex produced into a short apical lobe in lateral view, simply rounded in dorsal view; inner sac wholly covered with a compact mat of well sclerotized scales. Styles fairly large, each usually provided with four setae, three terminal and one subterminal, though an additional seta sometimes exists on one of them.

Type-series. Holotype: ♂, allotype: ♀, 1-XI-1962, S. UÉNO & Y. KUROSAWA leg. (NSMT). Paratypes: 1♂, 2♀♀, 3-XI-1954, Y. KUROSAWA leg. (NSMT); 55♂♂, 35♀♀, 1-XI-1962, S. UÉNO & Y. KUROSAWA leg. (NSMT); 17♂♂, 19♀♀, 4-XI-1962, S. UÉNO leg. (NSMT).

Type-locality. Cape Manazuru-misaki of Manazuru-chô, in Kanagawa Pref., on the Pacific coast of central Honshu, Japan.

Further specimens examined. 3♀♀, Aki-no-hama, Senzu, Is. Oh-shima of the Izu-shichitô Islands, off central Honshu, 10-XII-1977, S. UÉNO leg. (NSMT); 1♂, same locality, 6-III-1978, S. UÉNO leg. (NSMT).

Notes. The present subspecies occurs on the seashore like the other geographical races of *T. masidai*, but its habitats are always found near the high tide mark or just above it, not in the intertidal zone. It dwells under heaps of large stones at such spots as the freshwater enters into the sea, where it coexists with amphipods, isopods and small crabs.

At Cape Manazuru-misaki, there was a very narrow stream which emerged from under a cliff, flowed on the surface for several metres and sank under a heap of stones. Trechine beetles dwelled in the immediate vicinities of this stream, and were always found on the sand and silt at the bottom of the stone heap irrespective of the depth from the surface. The change in the environmental condition of this locality has made it difficult to collect the beetle now.

At Aki-no-hama on the Island of Oh-shima, which is about 46 km distant to the south-east from Cape Manazuru-misaki, the trechines were found from under large stones lying on sandy or clayey ground near the high tide mark. There was a seepage at the back of the small beach, which moistened a narrow belt of the ground down to the intertidal zone. Trechine beetles were taken only in this narrow humid place, though other littoral animals occurred everywhere along the beach.

Discussion

It is not easy to retrace the origin of *Thalassoduvallius*, since, to our present knowledge, its close relatives have never been found in East Asia including the Japanese Islands. Mor-

phologically, *Thalassoduvallius* is closest to *Duvalliomimus* of New Zealand, but the relationship may not be so direct as it appears to be. These genera resemble each other because they have certain primitive characters in common. Ecologically, however, they are decisively different; *Thalassoduvallius* is strictly confined in littoral habitats, often below the high tide mark, while *Duvalliomimus* is either ripicolous or cavernicolous. In my own field experience, the epigean species of the latter genus always live by running waters, usually under stones lying at the edges of narrow streams on mountains. JEANNEL (1962, pp. 174, 186–188) placed the two genera at the side of *Parepaphius* in his “Série phylétique d’*Epaphius*”, but this arrangement can also be disputed on the ground that his “série” was founded solely on the archaic condition of the preapical pore on elytra. It is possible that *Thalassoduvallius* and *Duvalliomimus* have been derived from a common ancestor, and in that case, the ancestral trechine must have originated in the Asian Continent. Even so, the differentiation between them must date back to a very old time, probably to the Tertiary or before.

In any case, the direct ancestor of *Thalassoduvallius* seems to have arisen in the Asian Continent and invaded Southwest Japan from somewhere in East China. The original immigrant must have colonized in Kyushu, though no representative of the genus has hitherto been known in that island. Once successfully established, the ancestral trechines began to disperse towards the northeast. Since they were unable to survive apart from the seashore, their dispersal must have been made along the coastal lines and, therefore, much affected by tidal currents.

The main ocean stream that influences the Island of Kyushu is the Black Current or the Kuroshio, which passes off the southern tip of Kyushu and flows along the southern side of the Japanese Islands. Of the four known localities of *Thalassoduvallius*, three (Uwajima, Cape Manazuru-misaki and Is. Oh-shima) are under the influence of this current. On the other hand, the northern side of Southwest Japan is washed by another stream called the Tsushima Current, which branches off from the Black Current, flows along the northwestern side of Kyushu and enters into the Sea of Japan. Only the Sufu-gawa population of *Thalassoduvallius* is under the influence of the Tsushima Current, and this is probably why it has become differentiated to a considerable extent from the others. The distance between the estuary of the Sufu-gawa River and Uwajima is about 190 km in a bee-line, while that between Uwajima and the Izu Area is about 650 km in a bee-line. And yet, the difference between the populations of the former two localities is more conspicuous than that between the populations of the latter two.

Next to be considered is the geographical differentiation of the populations under the influence of the Black Current. As was noted above, the Izu Area is very widely distant from Uwajima, but the differentiation of *Thalassoduvallius* is poor between these localities. This is most unexpected, since no other Japanese trechines that are apterous, microphthalmic and depigmented, have such a wide range of distribution as *Thalassoduvallius* has. Two reasons can be furnished for explaining this poor differentiation; one is that the distribution of *Thalassoduvallius* on the Pacific coast was continuous until very recently and that occasional interbreeding took place between individuals of neighbouring populations; the

other is that the eastward dispersal of *Thalassoduvallius* was accomplished so rapidly that morphological differentiation between different populations has not much progressed as yet.

Both the explanations may be true at least partially. Though the distribution of *Thalassoduvallius* is seemingly discontinuous, other populations of the trechines are expected to be found in the southeastern part of Shikoku, the Kii Peninsula and the Izu Peninsula. However, the difficulty in finding out their exact habitats makes it impossible to delineate an accurate picture of their distribution. On the other hand, *Thalassoduvallius* seems to have an ample chance of drift dispersal. Storm waves caused by typhoons frequently strike the Pacific coast of Southwest Japan, undercut coastal cliffs and take various things along. Once floating with rafts on the Black Current, the trechines can be easily carried for a long distance within a short time. Thus, we cannot deny the possibility that the existing distributional pattern of *Thalassoduvallius* was formed by hopping dispersal.

From the discussion given above, it can be readily understood that the immigration of *Thalassoduvallius* to the Island of Oh-shima must have been effected across the sea. As this volcanic island is not old in origin and therefore its shoreline is largely formed by recent lavas, habitable places are much limited for the littoral trechine. However, as the shortest distance from the Izu Peninsula to the Island of Oh-shima is only a little more than 22 km, invasions must have been, and still are, made incessantly. Some immigrants that happened to drift to favourable spots were able to settle isolated colonies on the island, an example of which can now be seen at Aki-no-hama on the northern coast.

要 約

イソチビゴミムシ類 *Thalassoduvallius* は、チビゴミムシ亜族の属種のうちでもかなり特異なものである。眼や後ばねが退化し、体の色素が多少とも消失しているため、外見が山地性のチビゴミムシ類に似ているが、海岸に堆積した石の下だけにすむという点ではほかに例をみない。潮間帯に固有の一群であるウミチビゴミムシ亜族 *Aepina* の種類ほど極端な特殊化は示さないが、潮間帯上部から満潮線のすぐ上までをすみ場所にし、とくに淡水が海に浸みこむようなところを好む。日本を含む東アジアからは近縁種がまったく知られていないので、系統的な由来は明らかでない。形態的には、ニュージーランドに固有で、山地の溪流付近や洞窟の中にすむ *Duvaliomimus* 属のものにもっとも近いが、この類似が直接的な類縁関係を示すものかどうかという問題については、なお検討の余地がある。

イソチビゴミムシ類は、これまでに西日本の2カ所から知られ、島根県浜田市周布川の河口で発見されたものがイソチビゴミムシ、愛媛県宇和島市の港で見つかったものがナンカイイソチビゴミムシと命名されていた。その後、同属のものが神奈川県真鶴岬で採集され、今回の調査では伊豆大島からも発見されたので、これらの資料を慎重に検討した結果、この属のチビゴミムシ類は、すべて同一の種であろうという結論に達した。しかし、地理的な変異は認められるので、ここでは既知の個体群を次の3亜種に整理した。

- 1) イソチビゴミムシ *T. masidai masidai* S. UENO —— 石見海岸
- 2) ナンカイイソチビゴミムシ *T. masidai kurosai* S. UENO —— 四国西海岸
- 3) イズイソチビゴミムシ *T. masidai pacificus* S. UENO —— 大島を含む伊豆地域

この論文で新亜種として記載したイズイソチビゴミムシは、宇和島産のナンカイイソチビゴミムシにきわめて近く、わずかに頭部の大きさや前胸背板の形状などの差異が、亜種を区分する特徴として認められ

るにすぎない。これに対して、石見海岸のイソチビゴミムシは、外部形態からみても雄交尾器の構造においても、他の2亜種とは明らかに異なり、分化がかなり進んだものであることを示している。直線距離にして190 km ぐらいしか離れていない石見海岸と宇和島のイソチビゴミムシが、明らかな分化を示しているのに対して、650 km も隔たった宇和島と伊豆地域のものが、ひじょうによく似ているという事実は、この類の分布や分化を考察する上でひとつの手掛りになる。

一般に、チビゴミムシ類は地理的な分化を起こしやすく、盲目種の極端な例では、1.5 km しか離れていない2地点で、完全な種分化のみられることさえある。無翅、淡色、小眼の種で、長さが数百キロメートルにも及ぶ広い分布域をもつものは、イソチビゴミムシ以外にまったく知られていない。単一の種がこれほど広く分布するようになった理由は、少なくとも二通り考えられる。そのひとつは、イソチビゴミムシの分布が連続的で、種を分化させるほど有効な隔離が起こらなかったのではないかと、という推測であり、他のひとつは、イソチビゴミムシの拡散が急速に行なわれた結果、まだ十分な分化を遂げるにいたらないのではなかろうか、というものである。おそらく、これらの推測はどちらも正しくて、ふたつの要因がたがいに補い合うような働きをしたのだろう。もちろん、現在の知見では、イソチビゴミムシの分布がきわめて不連続であるようにみえるが、生息条件がいちじるしく限定されていて、本来のすみ場所を探し当てるのがむずかしいことに起因する、見掛け上の現象だと考えてよかろう。

イソチビゴミムシ類の祖先は、おそらくアジア大陸から日本の南西部へ到達し、それから海岸沿いに北東へ拡がっていったものだろう。海岸を離れては生活できないので、拡散するにあたっては海流の影響を強く受けたはずである。したがって、黒潮に洗われる地域と、対馬海流の影響を受ける地域とのあいだで、まず分化が起こった。比較的距離の近い宇和島と石見海岸のものが、かなりの程度まで分化しているのは、おそらくこの理由によるのだろう。

いっぽう、宇和島と伊豆地域とは、ともに黒潮の影響を受けている。いったん潮流に乗ってしまえば、四国の南西部から伊豆半島へ到達するのに、それほどの時間はかからない。実際には、室戸岬や紀伊半島を経て東進が行なわれたことと思われるので、拡散はいっそう容易だったにちがいない。太平洋岸に分布する亜種の分化があまり進んでいない、という事実も、拡散分化の歴史がそれほど古くないことを示唆している。

伊豆半島のどこかに定着し、ある程度の分化を遂げたイブイソチビゴミムシの一部は、さらに海を渡って大島にもすみついた。この火山島は歴史が新しく、周囲の海岸にも環境条件の適当な場所がほとんど見当たらないので、イソチビゴミムシのように特殊な甲虫が分布しているのは、むしろ不思議なくらいである。しかし、伊豆半島から大島までの距離は、もっとも近いところで22 km あまりにすぎず、亜種の模式産地である真鶴岬からでも46 km しか離れていない。したがって、伊豆半島と大島とが陸続きにならなくても、イソチビゴミムシの渡る機会はたえずあったことと思われる。チビゴミムシ類が、あまり幅の広くない海峡を渡って拡散するのを助ける外力として、ここでは暴風にともなう洪水や高波を例示するにとどめておこう。

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Explanation of Plate 6

- Above: The habitat of *Thalassoduvallius masidai pacificus* S. UENO, subsp. nov., at Aki-no-hama on the Island of Oh-shima.
- Below: Close-up of the left lower portion of the above picture.

